

Media Independent Handover : WHITEPAPER

InterDigital[®]



Executive Summary

The growing demand for mobile broadband services is the catalyst for an ever-increasing variety of air interface technologies targeting local area to wide area connectivity. We envision that the network of tomorrow will be a “network of networks” that enables uninterrupted services when roaming across many different independent radio access solutions – a mega network transparent to the users.

InterDigital has been a pioneer in the development of Media Independent Handover (MIH) and helped define the IEEE 802.21 standard for seamlessly connecting GSM, WCDMA, WiMAX, WiFi, cdma2000 and virtually any other radio access technology. In practical terms, MIH technology provides operators with a virtual network extension and a platform for a range of new services – with minimal investment and low technical complexity – offering a better user experience with increased reliability and transparent coverage.

A typical MIH solution consists of a simple MIH client in the mobile device, an MIH server in the IP backhaul and requires no changes to the existing radio access network. Our seamless connectivity roadmap is rapidly evolving to enable additional services and capabilities that include LTE, IMS, Mobile TV and Cognitive Radio.

KEY MIH BENEFITS

Coverage Extension and Preferred Networks, as different radio access technologies can be combined to provide seamless connectivity to mobile users with converged devices. The MIH client algorithms enable handovers to a user's preferred network.

Load Balancing and Capacity Increase, for example, by off-loading a 3G network when hotspots are available. Traffic is spread across different radio networks to balance network loading, while increasing the number of users that can be supported across the entire access network.

Cost Efficiency and Simplicity of New Network Roll-outs, leveraging the existing radio infrastructure of cellular 2G/3G, WiFi and WiMAX networks, new hotspots and base stations – using any air interface – can be added dynamically to scale the overall radio network footprint and capacity of these combined technologies.

Flexible Network Architecture, since MIH is an IP-based solution that simply requires a thin client at the terminal and an MIH server in the IP backhaul, effectively future-proofing present networks.

Longer Battery Life, removing the need for performing periodic scanning of other radio access technologies at the mobile terminal, since MIH provides the availability of heterogeneous network services in a location-based manner.

No Radio Access Network Modifications, as the MIH client in the mobile node communicates with the MIH server for all local interconnections and handovers.

HETEROGENEOUS NETWORKS

The wireless industry has evolved rapidly, moving from the simple voice and text messaging to the next generation of services, devices and applications. Mobile voice, data and multimedia at high reliable speeds have become the norm and users' expectations on these services are higher than ever before.

While most new individual wireless technologies are capable of providing these services, the scarce and expensive frequency spectrum forces network operators to rely on heterogeneous wireless networks to satisfy the users' needs in different locations.

MIH satisfies today's customer expectations by enabling predictable and ubiquitous service – that's network and technology agnostic – when switching between networks. The technology overcomes the challenges of seamless network integration, requiring no user intervention, saving battery life and selecting the lowest cost connection.



MEDIA INDEPENDENT HANDOVER (MIH) TECHNOLOGY

Converged devices are already capable of handling multiple wireless technologies – such as GSM/WCDMA, WiFi, WiMAX or cdma2000 – in a single device. However, it has been challenging to deliver popular Web-based services, voice over IP (VoIP), e-mail, video and TV, across multiple locations, devices, network access technologies and operators.

The IEEE 802.21 MIH standard comprises a set of mechanisms that facilitate mobility across heterogeneous or hybrid networks by abstracting the link layer intelligence to higher layers, creating a common interface that treats all access technologies in a generic manner.

MIH specifies three media-independent services: Event Service, Command Service and Information Service. The Event Service (ES) provides a unified reporting mechanism that indicates, or may anticipate, changes in state or status of the link layers. The Command Service (CS) allows either the mobile client or the network function (MIH server) to control the parameters of a link, modify the behavior of the ES and initiate and coordinate the network switching. The Information Service (IS) provides database access and retrieval of network availability, parameters and services for both serving and neighboring access networks. Examples include information about heterogeneous geographical network maps, service costs, QoS functionalities and roaming partners. The IS also provides neighboring network information about user and network operator policies for optimal initial network attachment or network re-selection in idle mode.

The intelligent MIH connection-monitoring manager middleware sits between the application and the device radio modems to monitor the wireless accesses, network status and availability. The middleware interacts with the higher layers in a consistent manner to ensure seamless connection handover with minimal delays across different access protocols' coverage areas, with varying speeds and levels of quality of service (QoS) support.

Currently, IP mobility is typically provided by Proxy Mobile IP (PMIP) or Mobile IP (MIP) solutions. MIH provides the low layer mechanisms required for enhancing the performance of the IP-level mobility protocol, and it can equally be used with PMIP, MIP, Session Initiation Protocol (SIP) and even Dynamic Host Configuration (DHCP)-based solutions. The flexibility of MIH provides network operators with the ability to not only enhance current mobility solutions, but also future ones such as Voice Call Continuity (VCC), Service Continuity, and other IMS- and IP-based services

COST-EFFICIENT FOR NETWORK OPERATORS WITH IMPROVED ROI

MIH is a cost-efficient technology that can improve the Return on Investment (ROI) in several manners. First, new radio access technologies can be added without affecting the efficient operation of existing

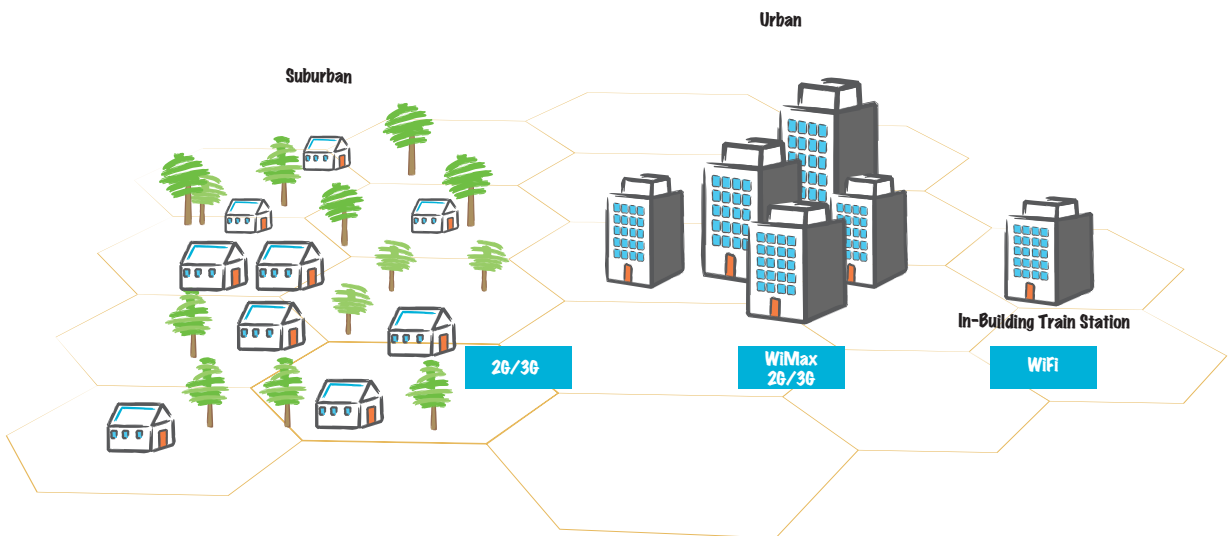
2G/3G, WiFi and WiMAX technologies. MIH provides enabled devices with seamless connectivity between these technologies, without affecting the operation and performance of existing legacy devices and radio access networks.

Second, operators can capture higher revenues from businesses and personal mobile data users by offering richer applications and more comprehensive packages, as well as bundling different radio access technologies.

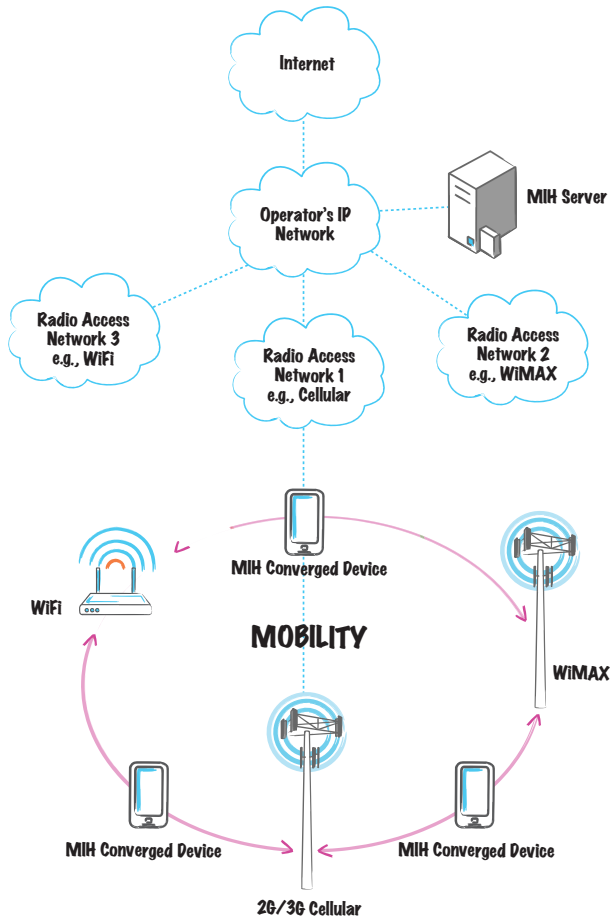
Third, operators can “go-where-the-customers-are” by providing scalable capacity to support hot spots where demand for both voice and data services is greatest.

COVERAGE EXTENSION AND LOAD-BALANCING

Since different radio access technologies can be coupled loosely, operators can perform dynamic load-balancing between these networks. For instance, data-only users are directed to data-optimized technologies – e.g., WiFi/WiMAX – where voice traffic remains on 2G/3G, augmenting the overall capacity with transparency, to the user.



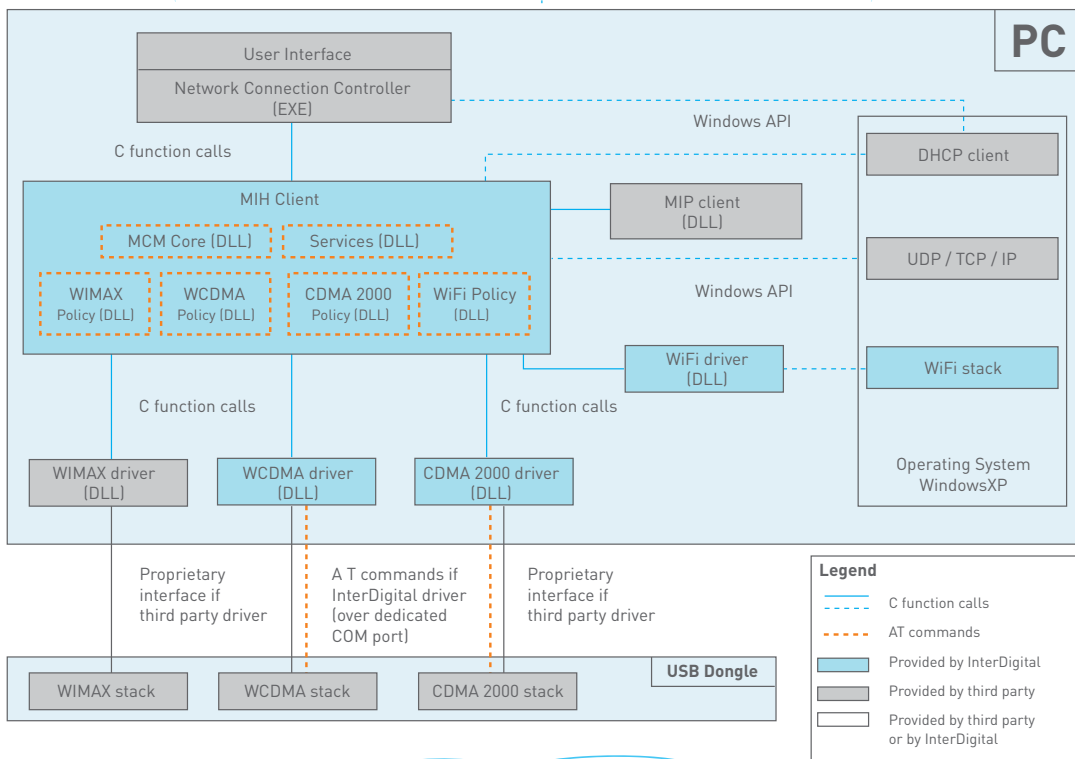
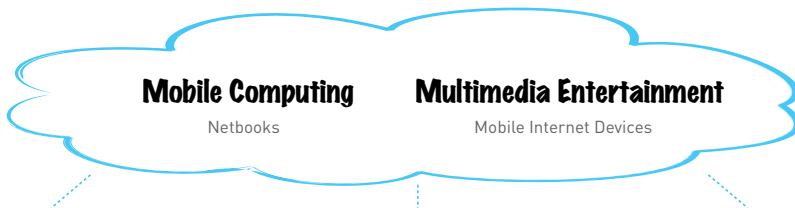
The simple MIH network architecture relies on a mobile client communicating over IP with an MIH server in the network.



MIH is also future-proof, since it can be transparently integrated with LTE, IMS and most future IP radio access networks.

INTERDIGITAL MIH CLIENT SOLUTION

InterDigital's MIH client uses standard APIs, function calls, an operating system abstraction layer and additional functions for easy integration into most mobile devices. The MIH client software supports event, command and information MIH services, and is common across laptops, smartphones, data cards and dongles.



MIH Client Interfaces to Netbook/MID

InterDigital's MIH client provides extensive error handling and logging support – coded with 50K lines of portable ANSI C source code and able to run as a 900 KB set of Dynamic Link Libraries (DLLs). Following the Mobility SW recommendations in GSMA "3G in Notebooks Guidelines", the standardized radio APIs communicate and control cellular modems through standard 3GPP/3GPP2 AT commands, WiMAX modems through standard 802.16g SAPs.

Mobility Applications Smartphones

For smartphones, the intelligent 802.21 MIH client runs in the Application Processor (AP) and interfaces to modems mapped to appropriate interface drivers. The Operating System (OS) abstraction layer supports different smartphone operating systems, such as Windows Mobile and Android.

InterDigital's MIH client accelerates IP layer handovers, decreasing the application layer interruption time from 15-20 seconds down to 0-500 milliseconds without any buffering, bi-casting or other common enhancement techniques. It also helps extending multi-radio battery life, avoiding the need to perform scanning for other radio access technologies.

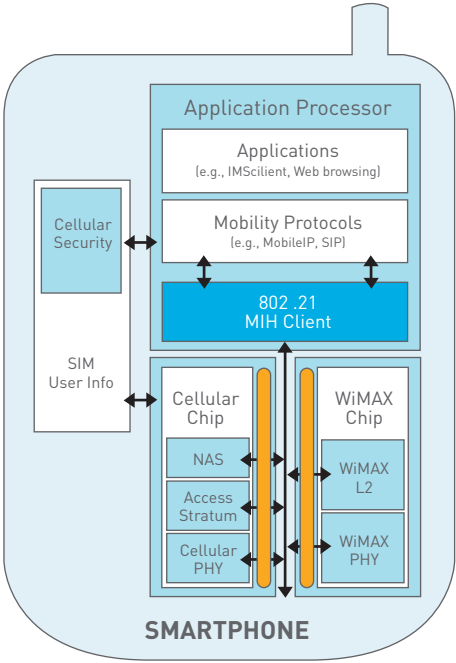
InterDigital's MIH client supports GSM, WCDMA, WiMAX, WiFi and cdma2000 radio interfaces, and our seamless connectivity roadmap is rapidly evolving to enable additional services and capabilities that include IMS (SIP/VCC), Mobile TV and Cognitive Radio.

The intelligent MIH client technology has been fully proven and interoperability tests (IOTs) have been conducted with third party servers. Also, our next generation solution has been demonstrated publicly interoperating with a third party server over the Internet.

The integration of InterDigital's MIH client middleware allows forward-looking manufacturers of multi-mode devices assure forward compatibility to new radio access networks, even before these networks are deployed.

MORE OPPORTUNITIES FOR APPLICATION DEVELOPERS AND CONTENT PROVIDERS

Seamless connectivity provides greater opportunities for application developers and content providers. The MIH technology opens a broad new market for rich voice and data applications that are optimized in the "always on" mode, enabling users to stay connected to the Internet at all times.



MIH Client Interfaces to Smartphone

CONCLUSIONS

The basic attributes of the MIH technology create significant advantages and benefits for network operators, equipment manufacturers, application developers and users.

FEATURES	ADVANTAGES	BENEFITS
Simple architecture requiring only a middleware client at the mobile, and an MIH Server in the IP network	Does not require any changes to existing radio access networks	Low Capex cost solution and faster time to increased ARPU
Seamless connectivity between independent radio access technologies	Allows performing load-balancing between different radio access networks and increases the overall number of users supported	Higher profit margins per user
MIH technology standardized by the IEEE 802.21-2008 and IETF MIPSHOP specifications	Complementary to IETF mobility protocols such as PMIP, MIP, SIP and DHCP	Low risk, lowest cost solution for operators and users
Multi-mode converged devices can be in the always-on mode without compromising on battery lifetime	Better customer satisfaction about operator's services	Lower churn
Compatible with GSM, WCDMA, WiMAX, WiFi and cdma2000 technologies	Immediate application to existing deployed networks	Increased ARPU
Support of current and future services (LTE, IMS, VCC, DVB, etc.)	Future-proof technology	Lowest Capex cost solution
MIH client can work in mobile-controlled or network-controlled mode	MIH works transparently and does not require any user intervention	Lower operating cost

